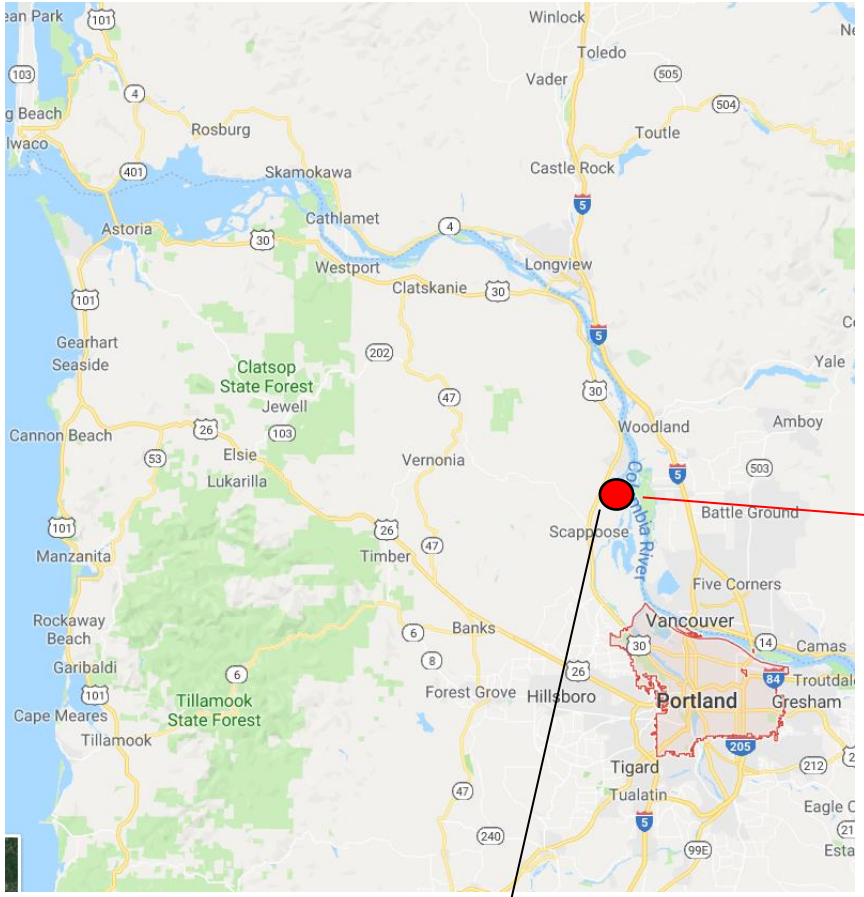
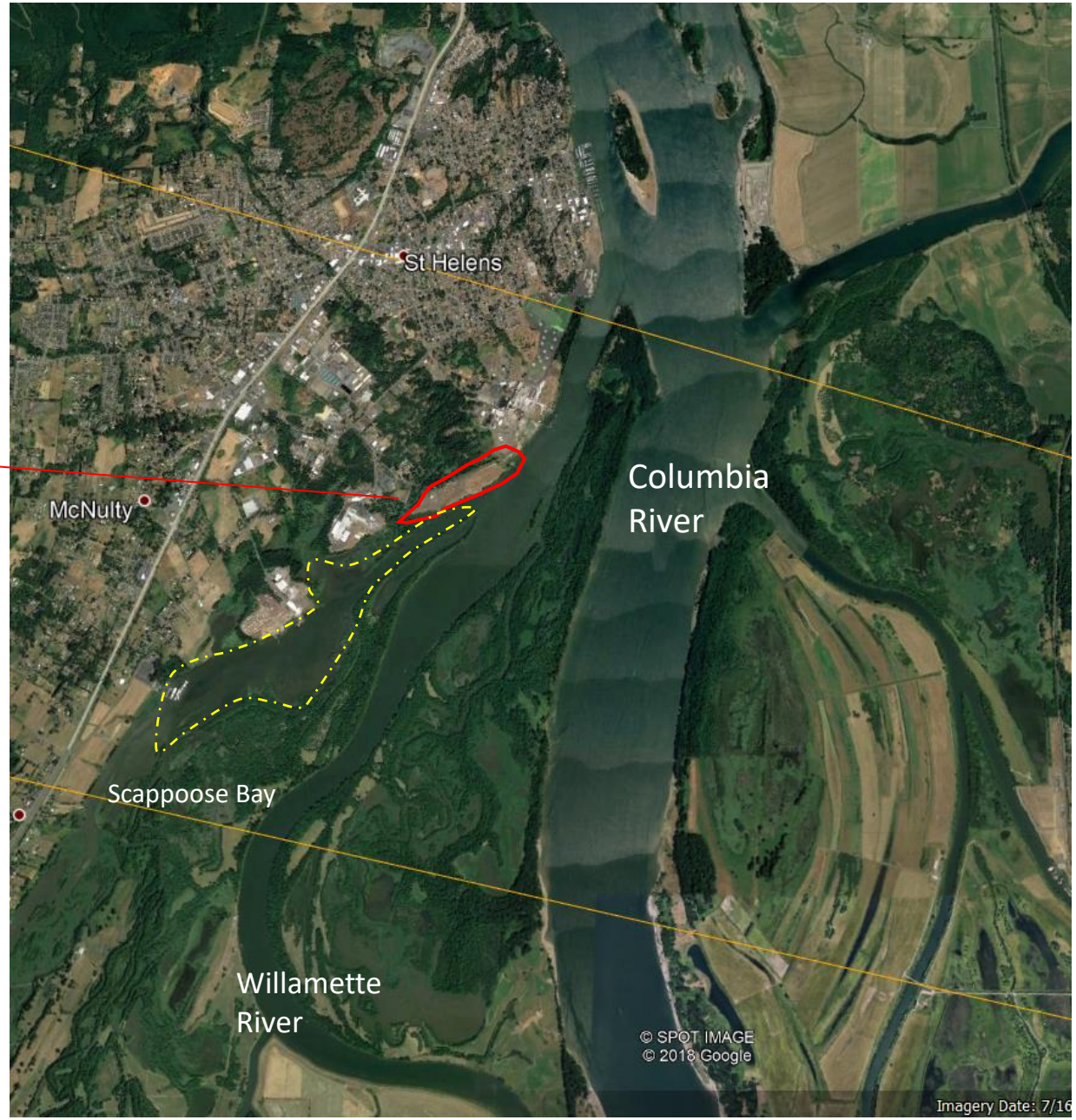
Sampling Sediment and Porewater in the Lower Willamette River St. Helens, Oregon

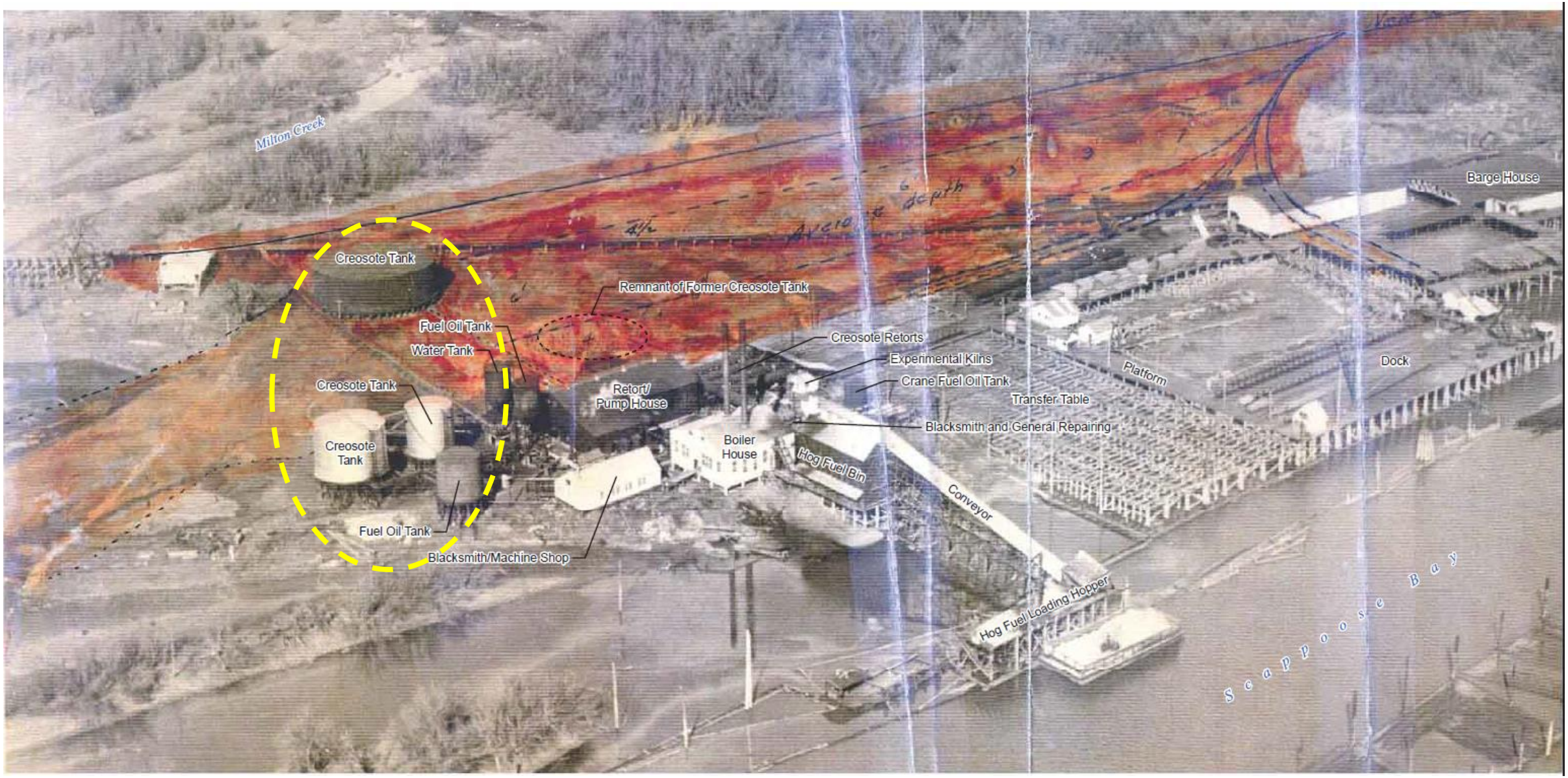
Henning Larsen, R.G.

Oregon Dept. of Environmental Quality





Former Pope and Talbot
Wood Treatment Facility
St. Helens, Oregon



Pope and Talbot Facility Circa 1929 - Operations Ceased in 1960

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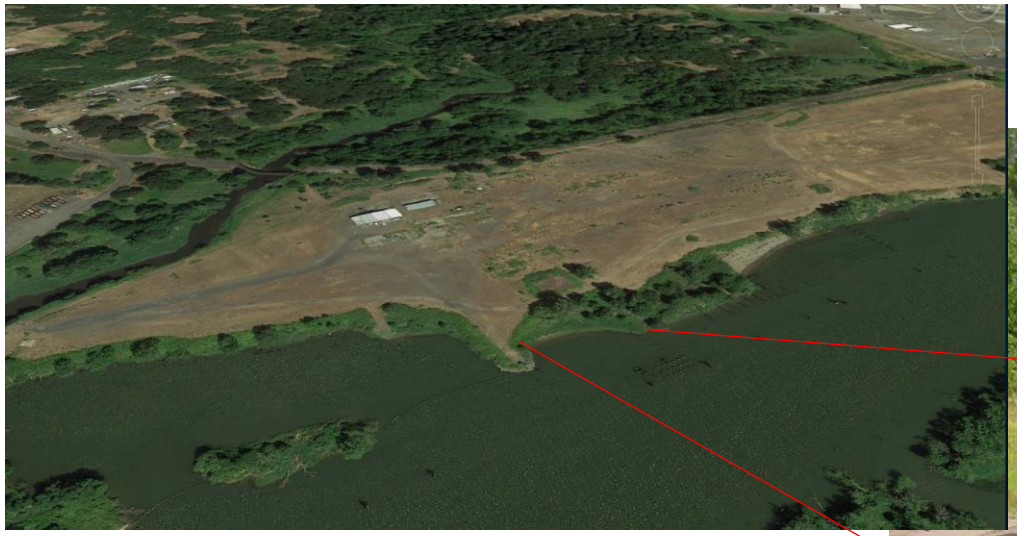
How it Looks Today



Former facility and operational areas covered by 2 -21 ft of river dredge spoils

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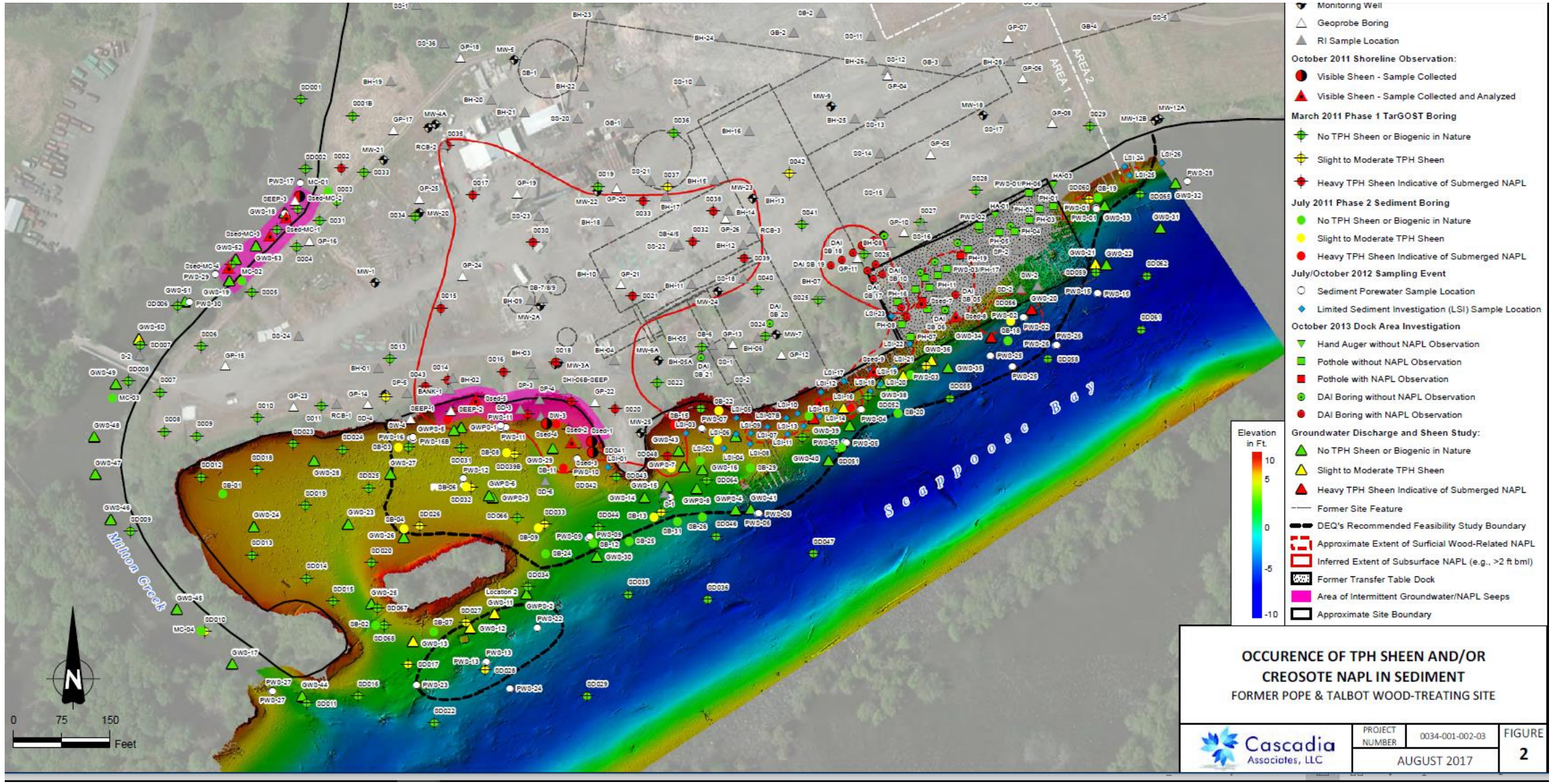
Former Pope and Talbot Facility - In-Water Remedial Investigation



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Creosote saturated wood waste

Conditions Beneath the Surface

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Surface Water Sheens

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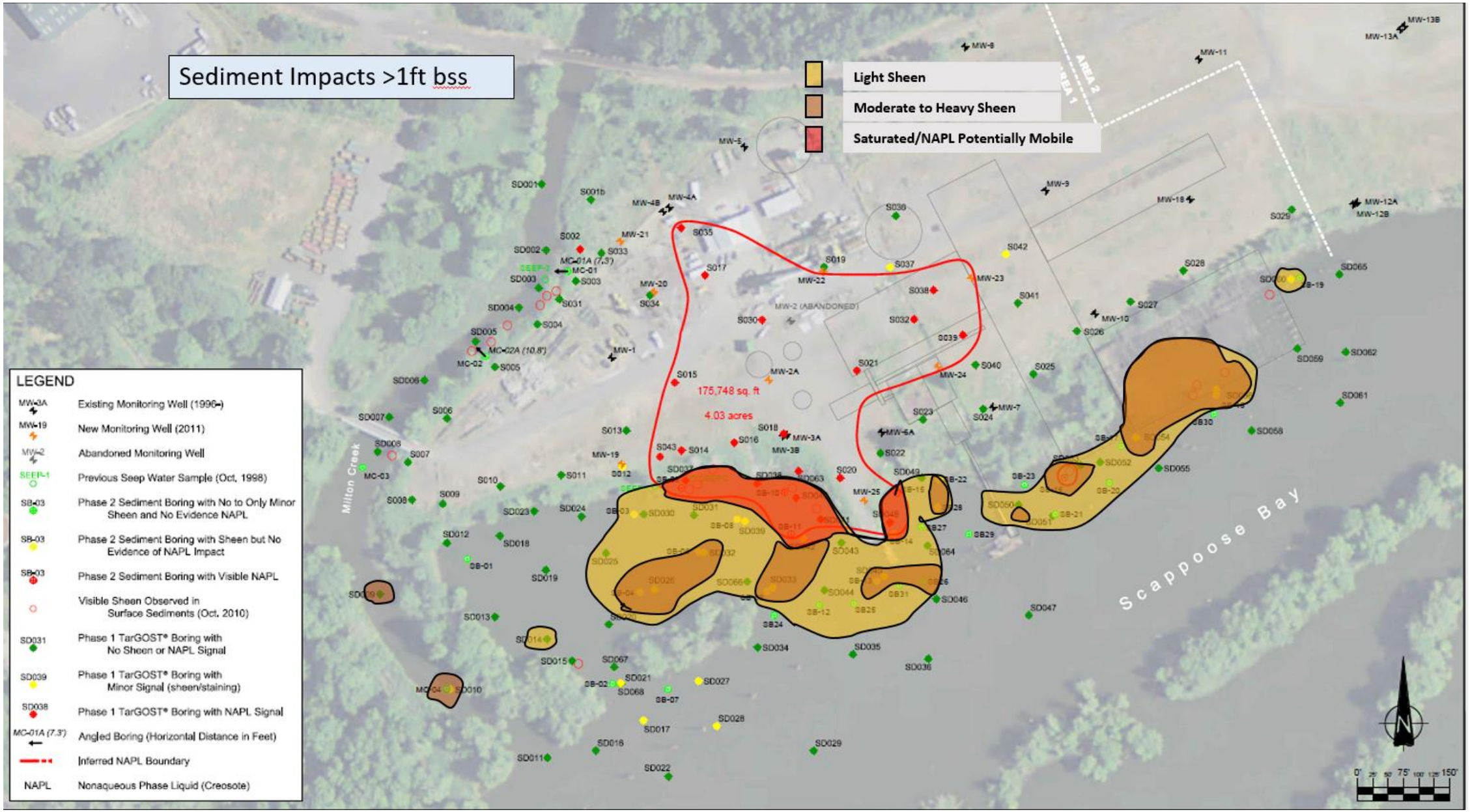

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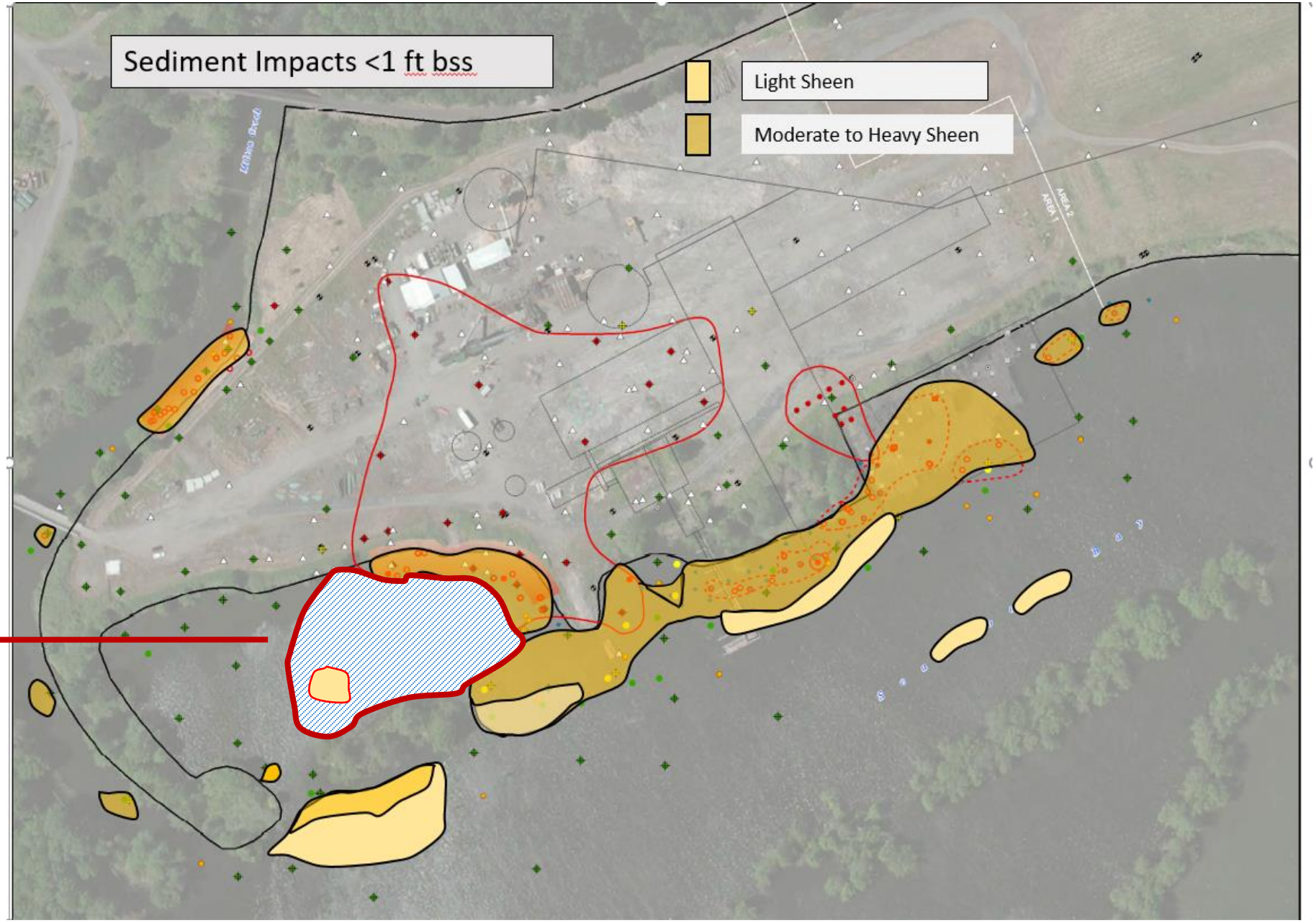
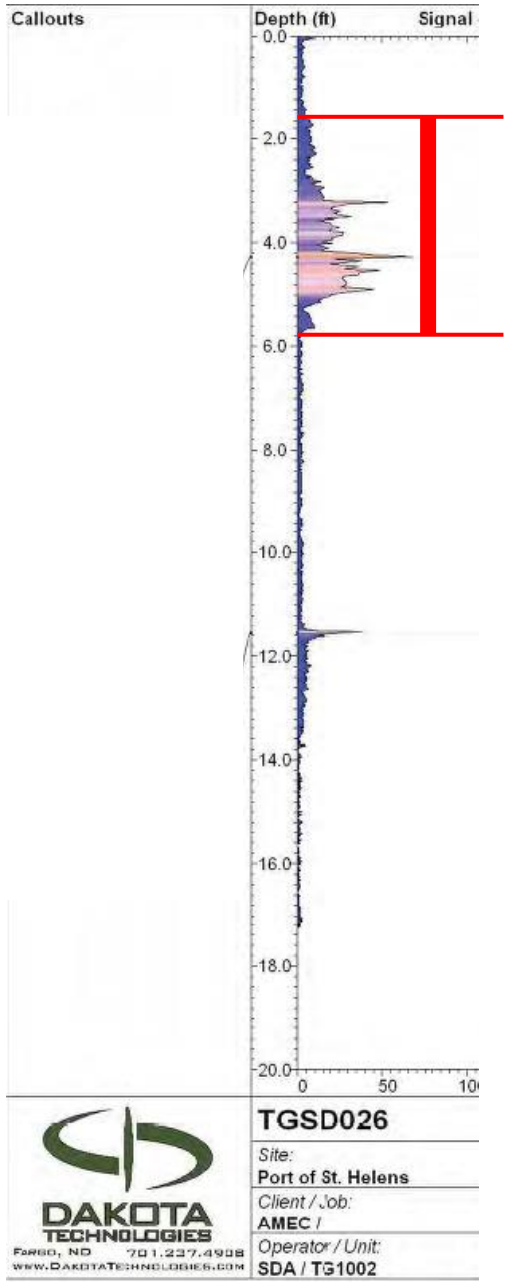
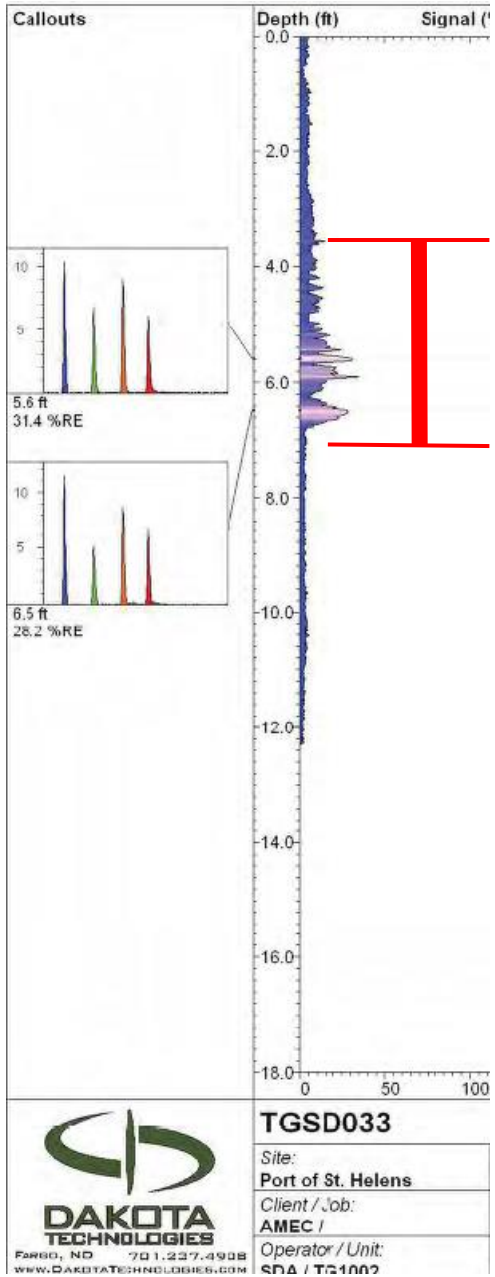
Focus of Pore Water Evaluation

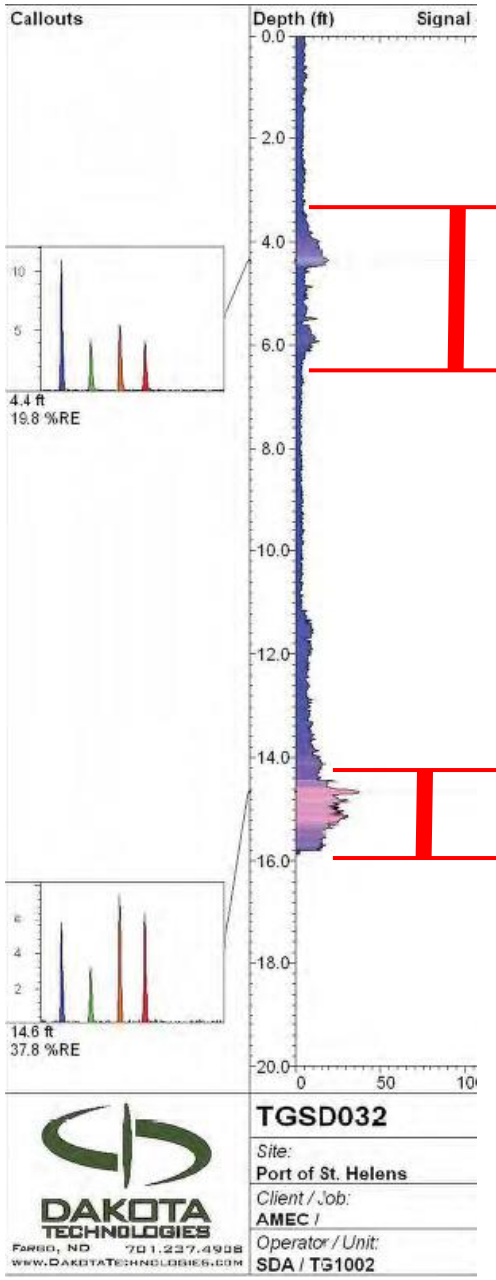
Approximately 2 acres of Sediment area with 2-3 ft thick creosote contaminated wood waste covered by 2-6 ft of fine texture sediments deposited over the last 60 years



Creosote contaminated wood waste buried 2-5 ft bss in the “Man-made Cove”as detected by Targost







Approach – Focused Assessment of Exposure Point Concentrations in the Benthic Environment

Develop a Conceptual Site Model for Benthic Habitat

- Define the depth of the biologically active zone
- Identify sampling periods representing relatively worst-case seasonal conditions
- Develop a vertical profile of contaminant levels in Sediment and Pore-water
- Apply a robust analytical program reflecting the complexity of petroleum chemistry

Determining the Depth of the Biologically Active Zone

Literature Review

Table 5. Biologically Relevant Sediment Depths—Biotic Zones—for Decisions Related to Ecological Assessment or Remediation. The biotic zone noted in column 2 is

Habitat Type	Biotic Zone (cm)	Biotic zone (cm) (Considering Biomass)
Lotic		
Stream Coarse Grained/Sand	35	
Stream Coarse Grained/Sand with Fines[b]	25	
River Coarse Grained/Sand with Fines[b]	15	

DETERMINATION OF THE BIOLOGICALLY RELEVANT SAMPLING DEPTH FOR TERRESTRIAL AND AQUATIC ECOLOGICAL RISK ASSESSMENTS

EPA/600/R-15/176
ERASC-015F
October 2015

Direct Observations using “Powergrab” version of the clam shell-type sampler

- Bioturbation
- Redox Conditions
- Substrate/Sediment Texture and composition

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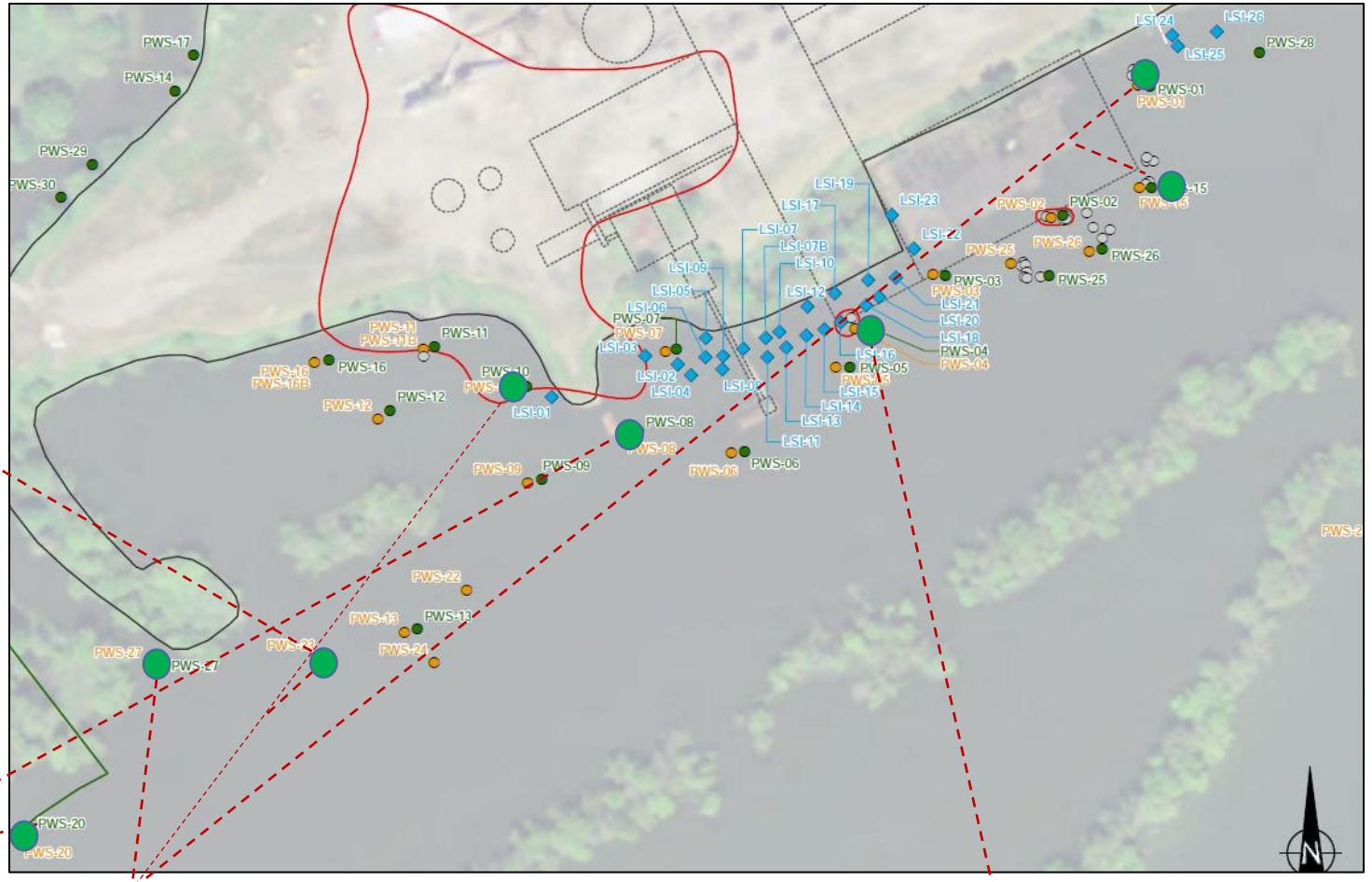
Macroinvertebrates Observed in the Upper Foot of Sediment

Corbicula (4” bss)

Lamprey Ammocetes (2-5” bss)



Oligiochetes
(3-12” bss)

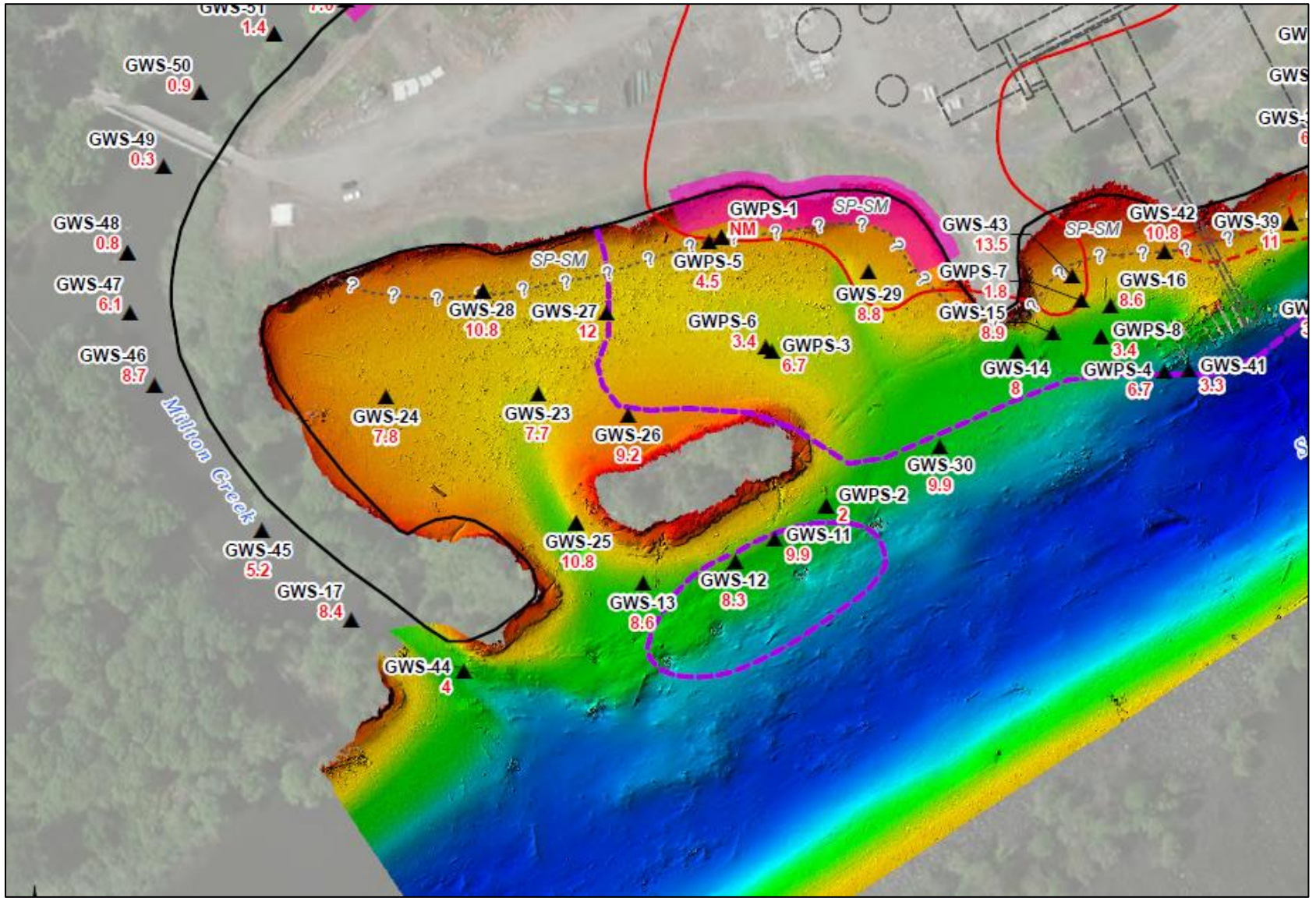
Crayfish
(3.5” bss)

Mapping Bathymetry and GW Discharge Areas

Multibeam Bathymetric Survey
+/- 5 cm

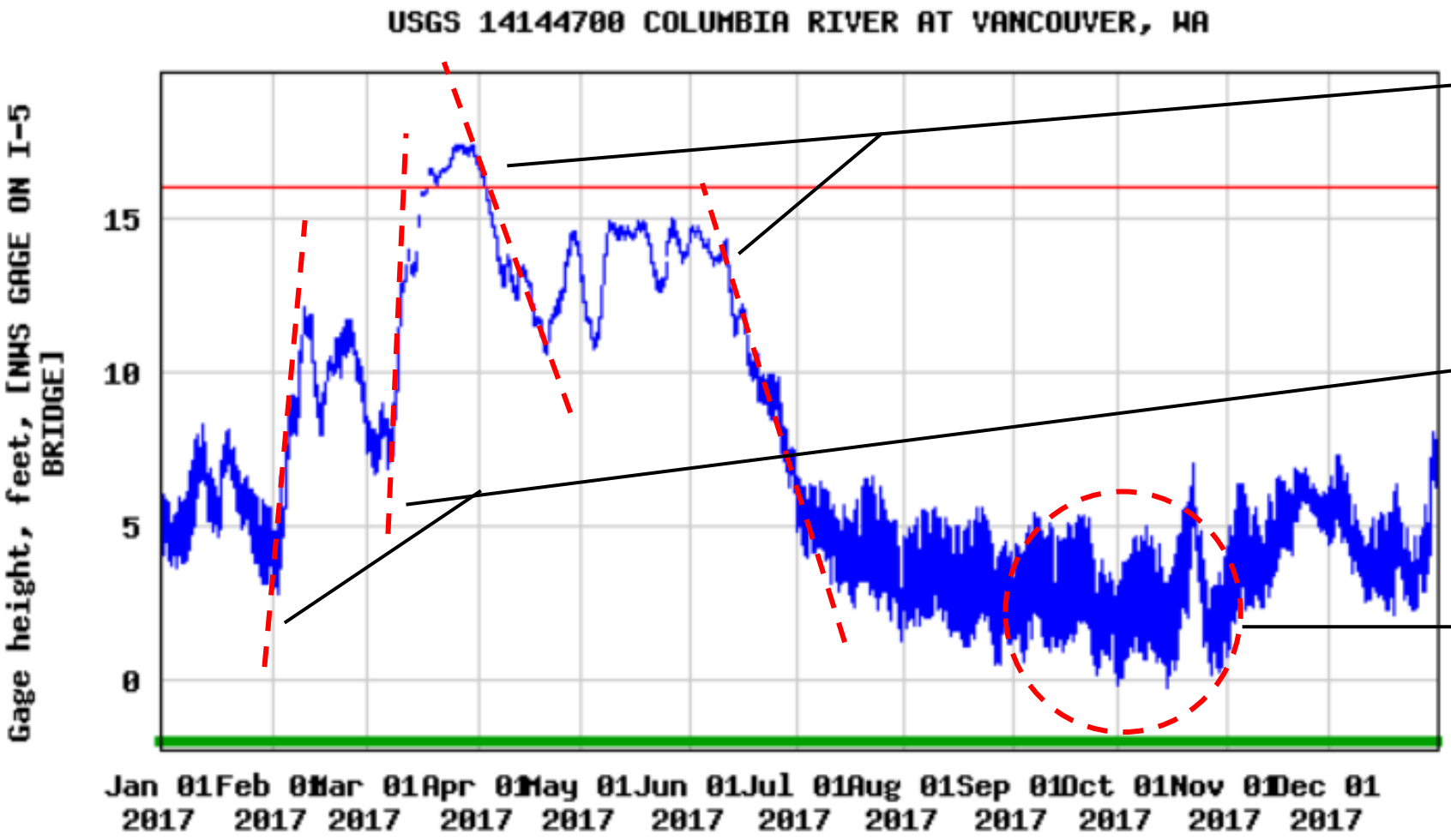
Thermocouple Temperature Sensor +/- 0.1° F

(8.4) = Surface water minus porewater at 8" bss – degrees fahrenheit



Temperature Survey July 2017

Selecting the Period for Sampling



Falling Limbs – Periods of Maximum Groundwater Discharge and Contaminant Flux

Rising Limbs – Periods of Reversed Gradients – Bank Storage

Low stage - Baseflow period, strong tidal oscillations

Seasonal Changes in River Stage

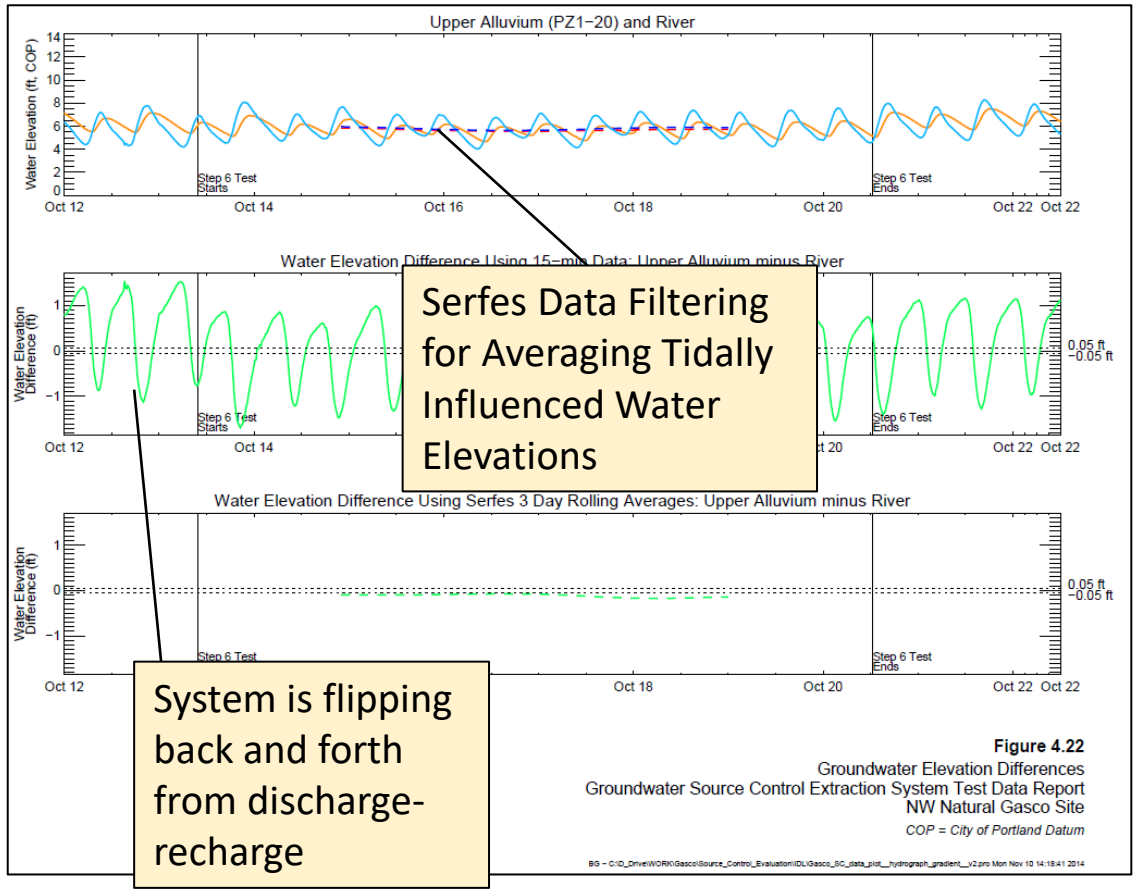
- approximately 15 feet in 2017

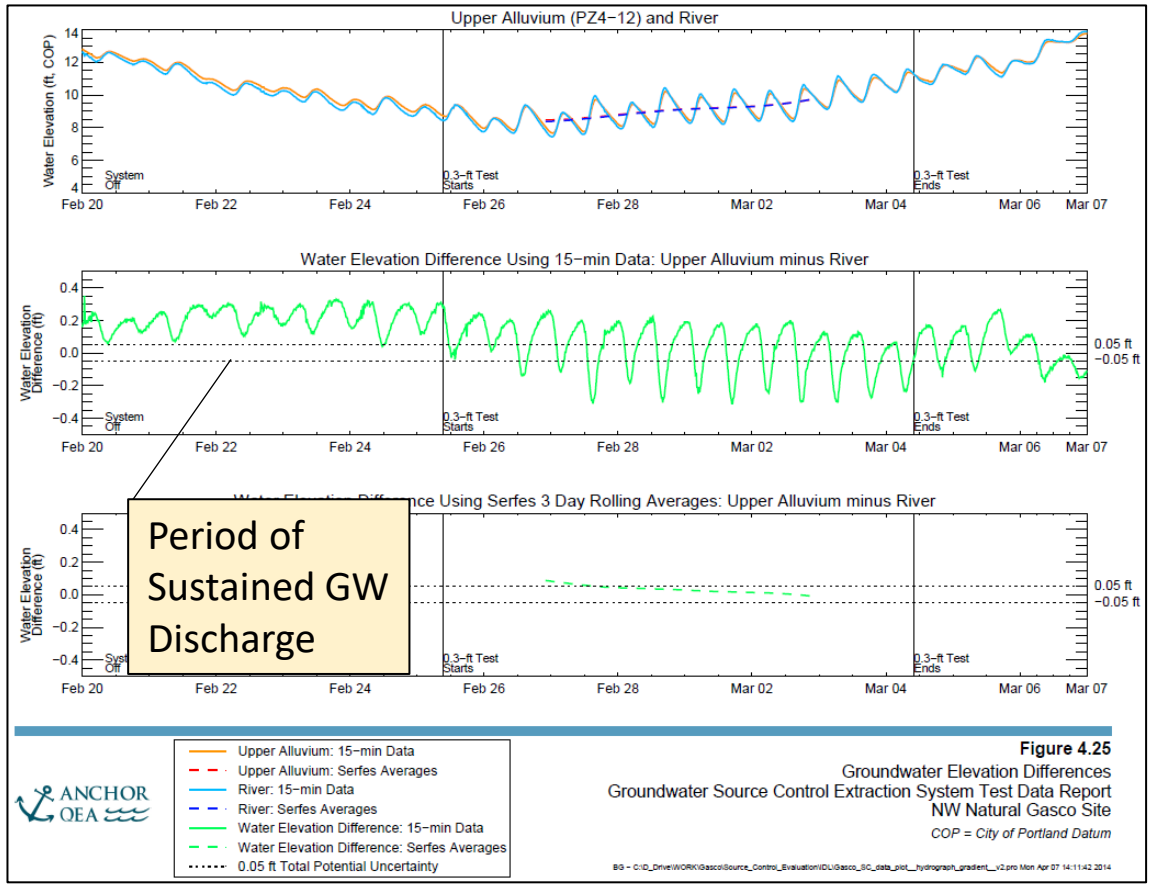
October 1, 2009

June 29, 2011

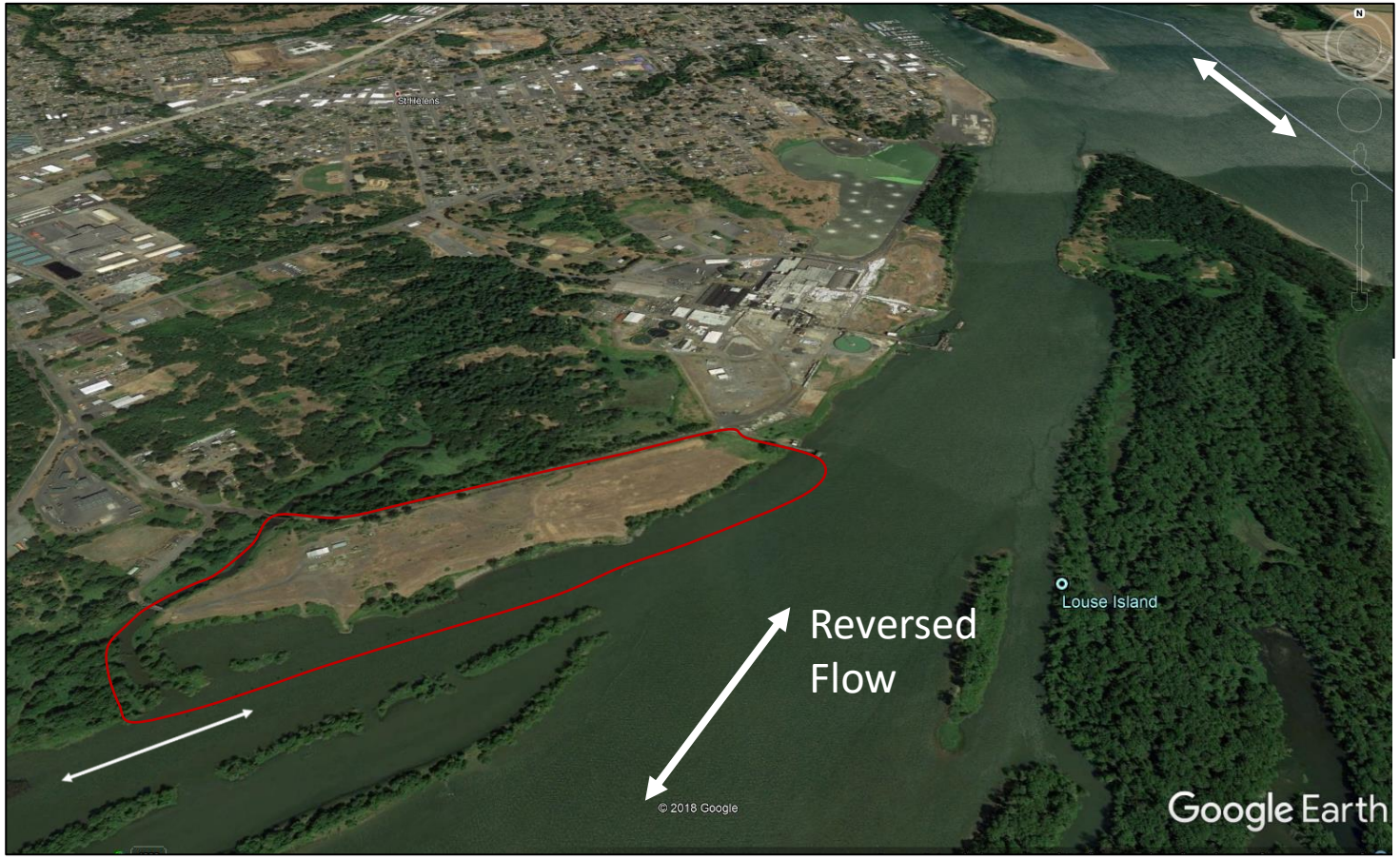
Continuous Elevation Monitoring of GW and SW - Seasonal Gradient Analysis

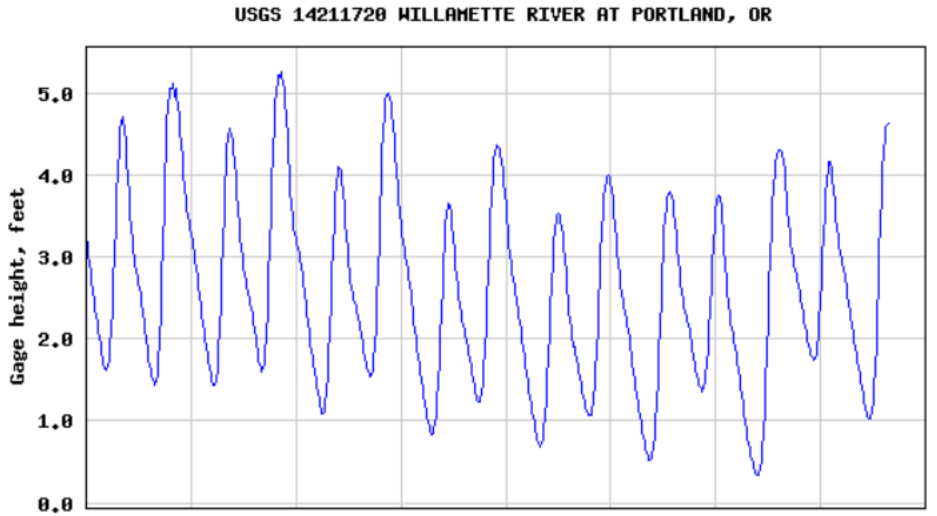
Hydrographs from GASCO Site located15 miles upstream

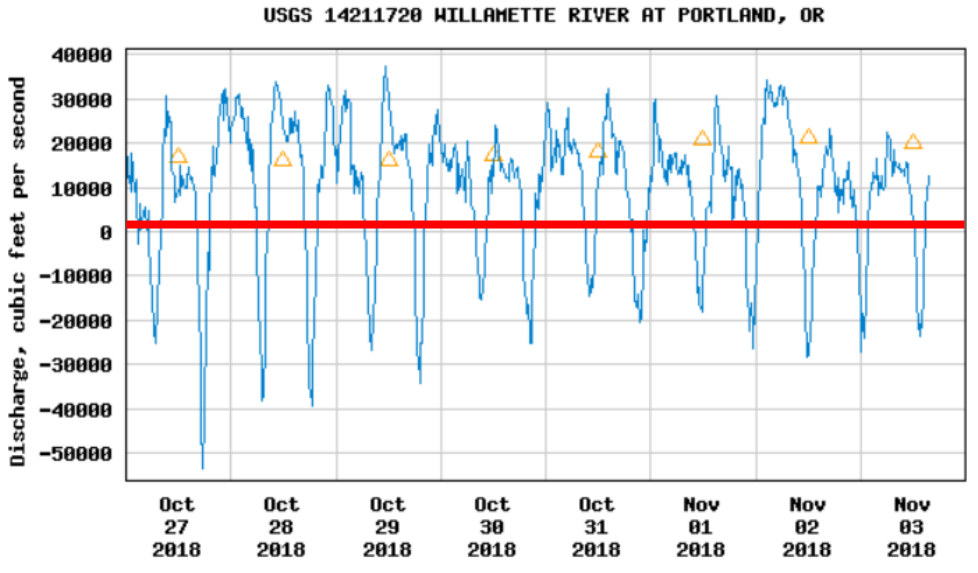




Selecting the Sampling Duration







Diurnal Tidal Oscillation in River Stage and Reversal of Flow

Summary of Findings and Decisions

- Biologically Active Zone at a minimum extends to 30 cm below the sediment surface. Sampling depth chosen to evaluate impairment of aquatic habitat - 22.5-27.5 cm bss
- No areas of focused GW discharge identified. Data interpretation is uncertain.
- Based on bathymetry, positioned several porewater sampling locations to evaluate horizontal transport of dissolved-phase contamination
- Based on GW-SW gradients, water temperature, and logistics - July and October chosen for sediment porewater sampling
- Pore-water initially analyzed using the ASTM method D7363-13a Method for Determination of Parent and Alkyl Polycyclic Aromatics in Sediment Pore Water Using Solid Phase Micro-Extraction (SPME)
- Shifted to polyethylene (LDPE) strips for 3rd round of pore-water sampling to provide longer-term 28-day exposure period for evaluating chronic ecological risks during periods of high tidal fluctuation

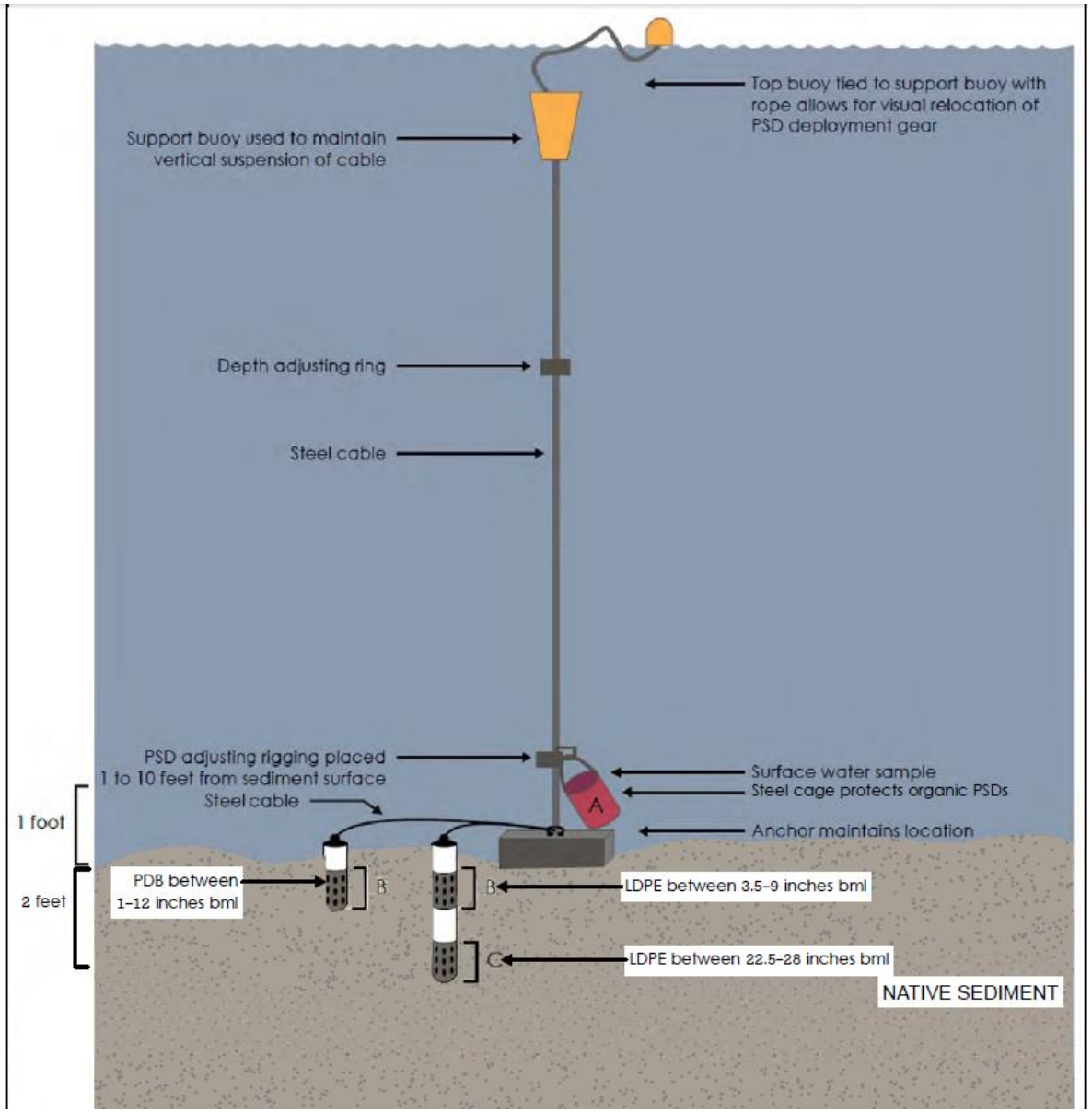
Sampling Devices

Surface Water Sampling Cage Containing LDPE Media

Sediment Probe with PDB

LDPE wrapped column within the sediment probe

Deployment of LDPE and PDB Samplers



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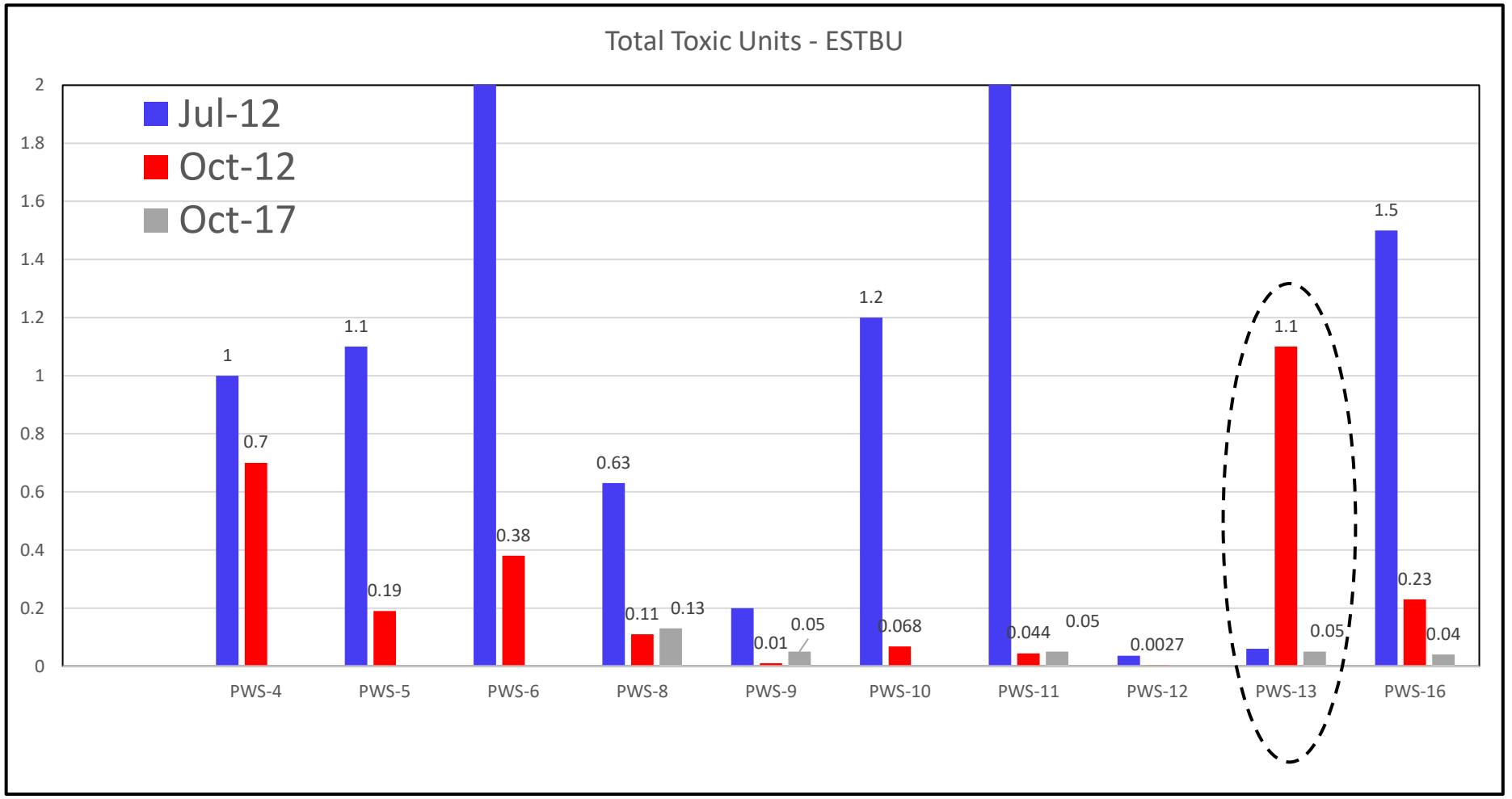
Seasonal Variability in Porewater Concentrations



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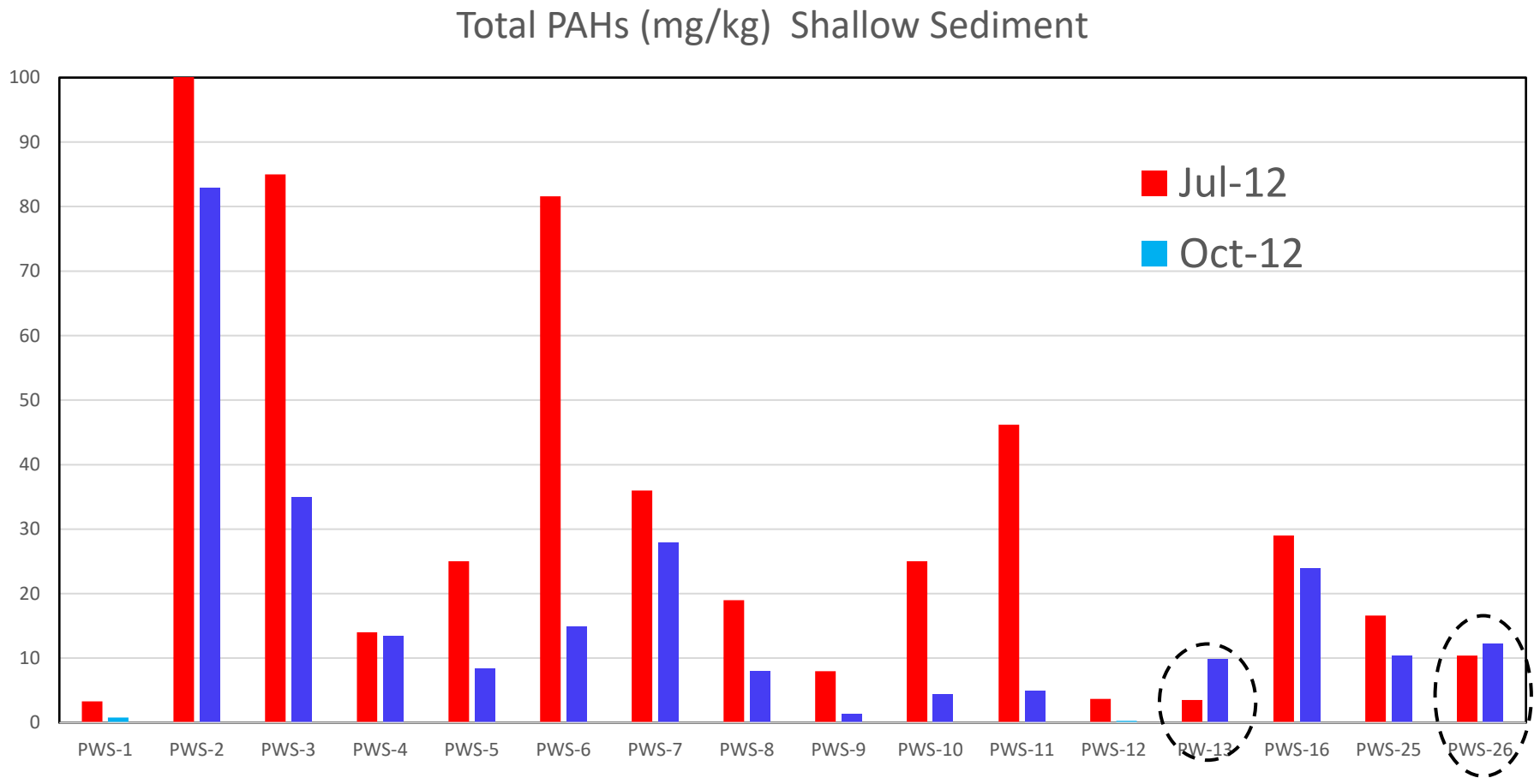
Seasonal Variability in Shallow Sediment PAH Concentrations



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Vertical Distribution of Freely Dissolved PAHs in Porewater (IWTUs)